FORTA-FI®

High Tensile Strength Synthetic Fiber Reinforcement for Asphalt Pavement

VPRIS June 2018

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FORTA®

What FORTA-FI® Can Do


FORTA-FI
Fiber Reinforcement Technology
FORTA
800-245-0306

=


Longer lasting
road ahead


FORTA-FI
FORTA
800-245-0300

=


ROAD
WORK
AHEAD

Drum & Batch Plant

How to add fiber!

EASY TO USE

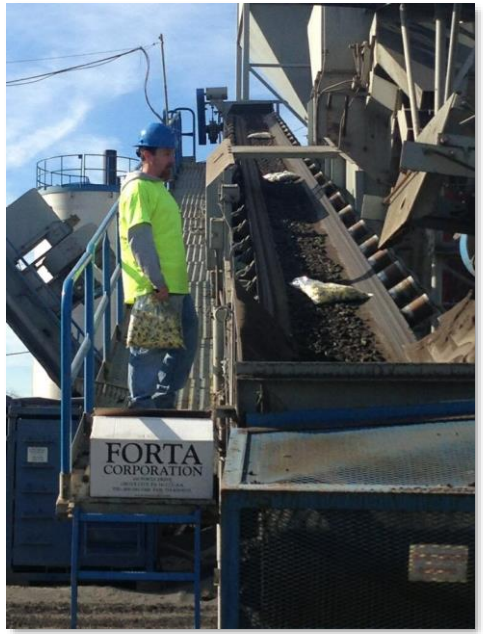
- easily metered automatically or manually
- mixes in drum plants and batch plants
- mixes thoroughly in seconds
- distributes uniformly

NO MODIFICATIONS needed to:

- your current asphalt mixture
- asphalt plant
- placement or compaction practices

TESTED AND PROVEN

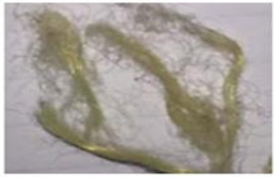
Extensively tested with proven results!



FORTA® Voyager Advantages

- **EXCEPTIONAL ACCURACY:** Reduce the opportunity for mistakes! Waste less fiber with the Voyager fiber dispenser.
- **EASY TO USE:** Simply add the fiber to the unit and step away.
- **IMPROVES INVENTORY TRACKING:** Easy-to-read displays allow for simple fiber tracking that updates in real time.
- **DISPENSES MOST TYPES OF FIBER:** The Voyager Fiber Dispenser is compatible with a variety of fibers.
- **IMPROVES EMPLOYEE SAFETY:** No need for workers to climb up stairs to introduce fiber into the mix.
- **CAN REDUCE WORKER COMPENSATION COSTS:** With improved safety - save money with fewer job related injuries!
- **REDUCES LABOR COSTS:** Less workers needed for a job.

Dispersion…

State	Definition	Example
Bundle *(Least Desired)*	A group of many aramid fibers that shows no clear indication of disturbance. This is the original condition of aramid fibers.	
Agitated Bundle *(Least Desired)*	A grouping of aramid fibers similar to the bundled condition, but that that has been visually agitated and has lost some of the individual aramids.	
Cluster *(Less Desired)*	A grouping of individual aramid fibers that are more dispersed than the agitated bundle.	

Specimen ID	Equivalent Aramid Dosage Rate (oz/ton)	State of Aramid (%)		
		Agitated Bundle	Cluster	**ADSR (Individual)**
FORTA-FI 1	2.2	2	8	**90**
FORTA-FI 2	2.2	0	13	**87**

“The smallest calculated LCCA is 20%...”

- The cost of fiber-reinforced mixture per 1000 cycles of fatigue life per mile was $288, whereas for the unmodified mixture it was $543.
- The cost of fiber-reinforced modified mixture per cycles of rutting life per mile was $1712, while the unmodified mixture was $6567.

Mechanistic Analysis and Economic Benefits of Fiber-Reinforced Asphalt Mixtures – pg. 20

Tripathi, A., and Souliman, M.

Submitted for the Presentation and Publication at the 2018 Annual Meeting of the Transportation Research Board

Asphalt is made up of:

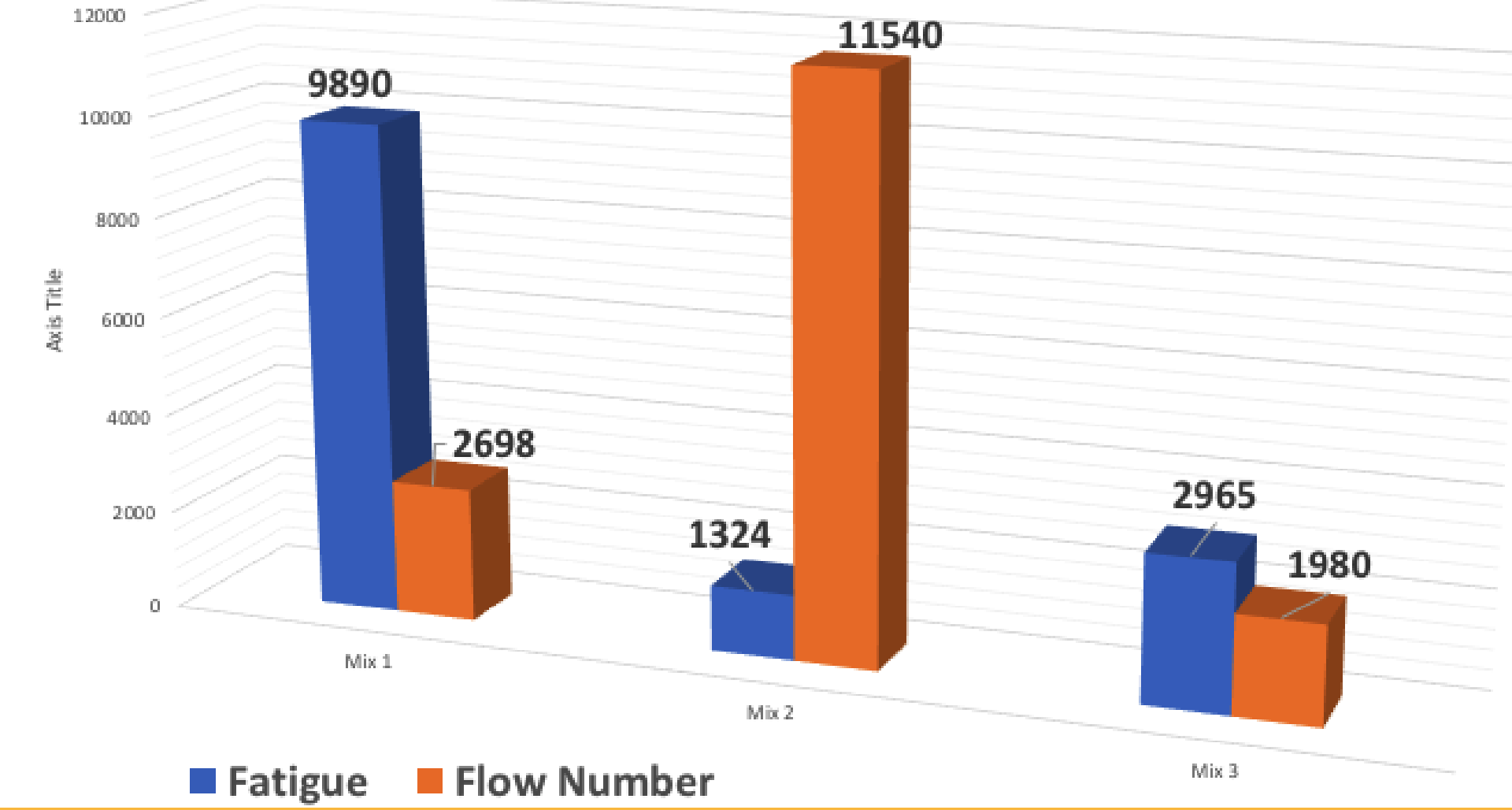
Rock,
Sand, &
Aggregates

+

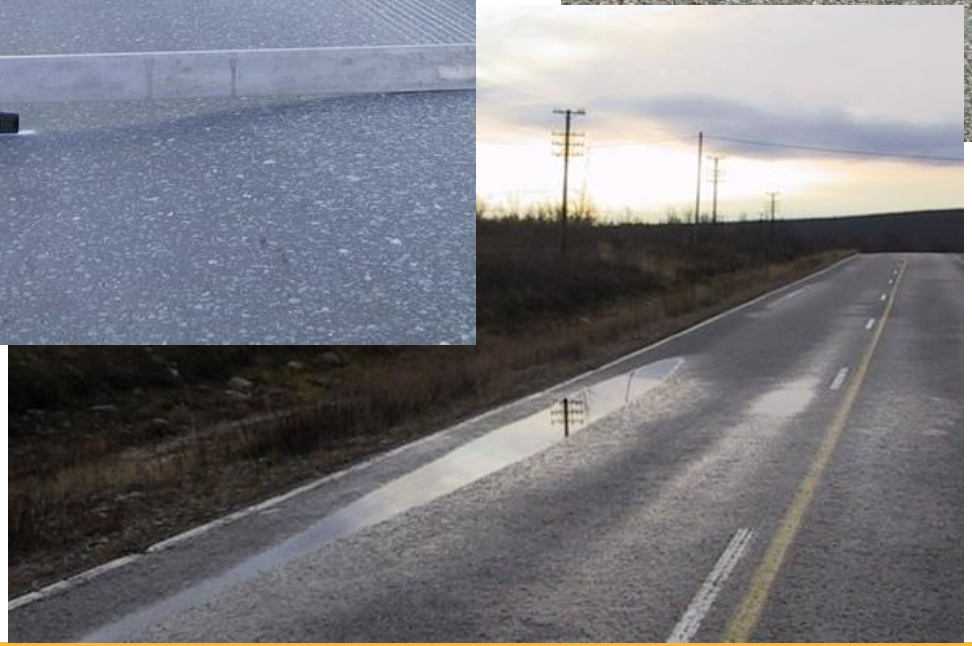
Asphalt Cement
(the binder)

Mix Design &

= NO CHANGE

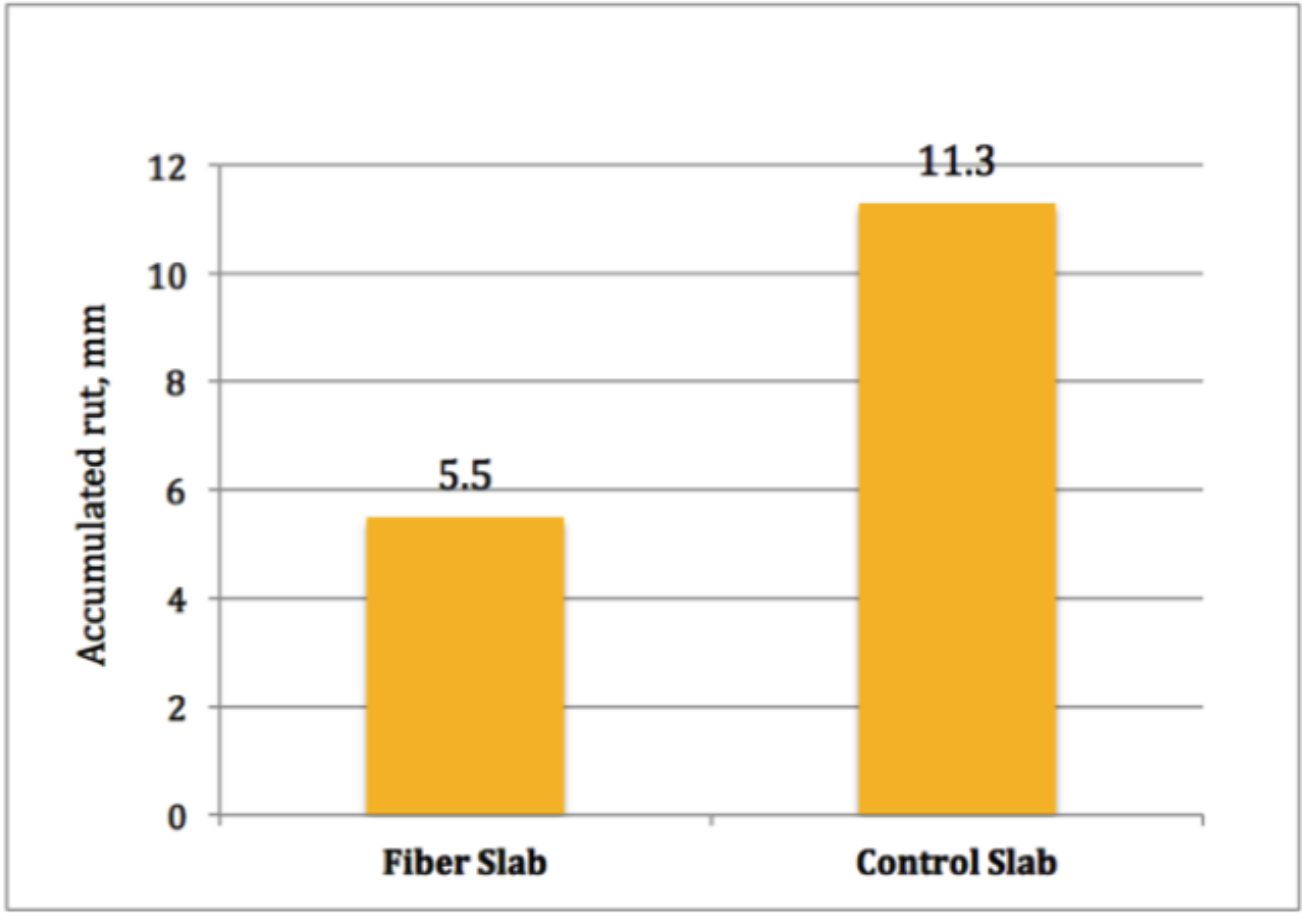

12000
10000
8000
6000
4000
2000
0
Axis Title
9890
2698
1324
11540
2965
1980
Mix 1
Mix 2
Mix 3
Fatigue
Flow Number

Distresses



Rutting

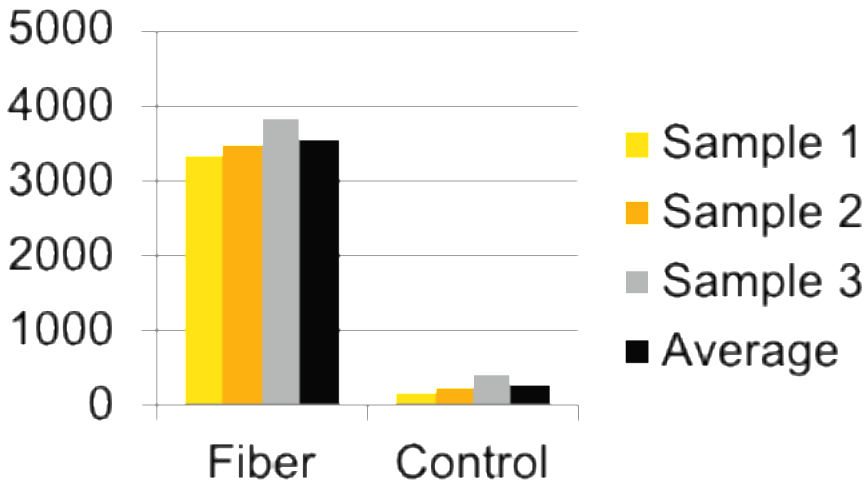
- ✓PSU - MMLS3
- ✓50% - Less



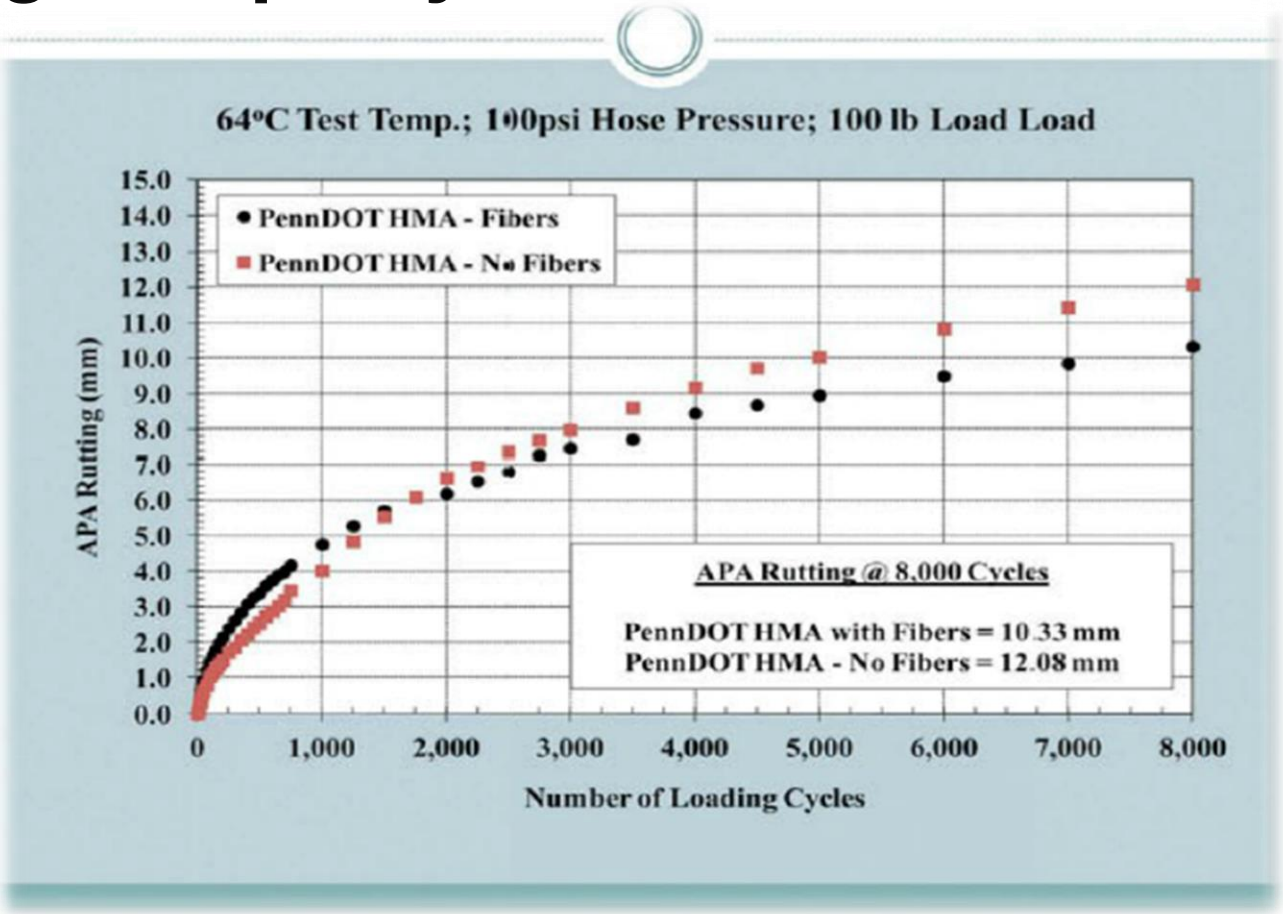
Rutting Evaluation

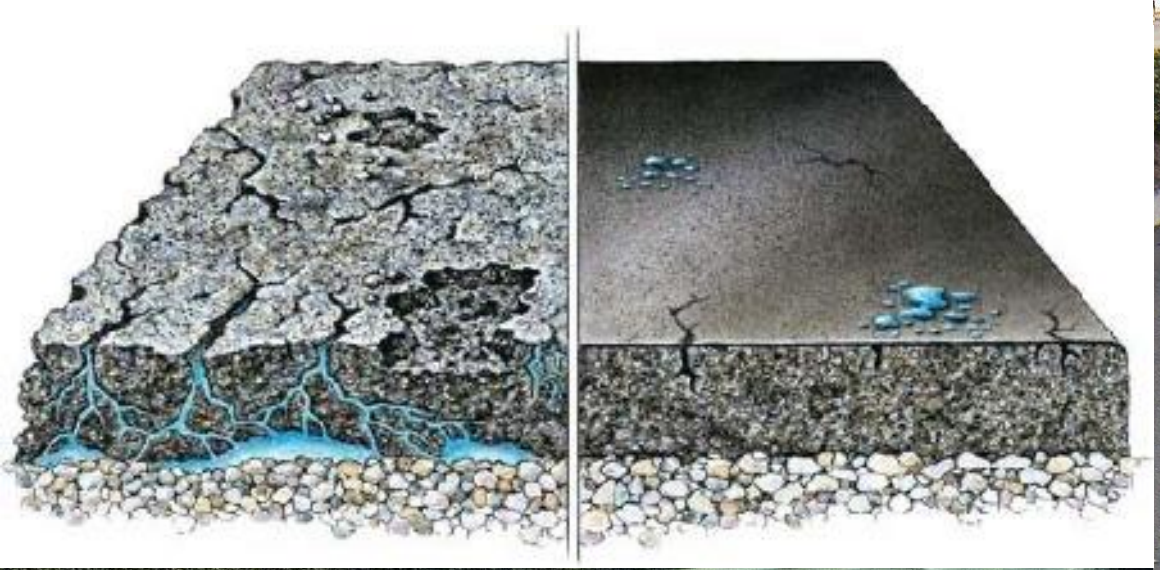
Flow Number:

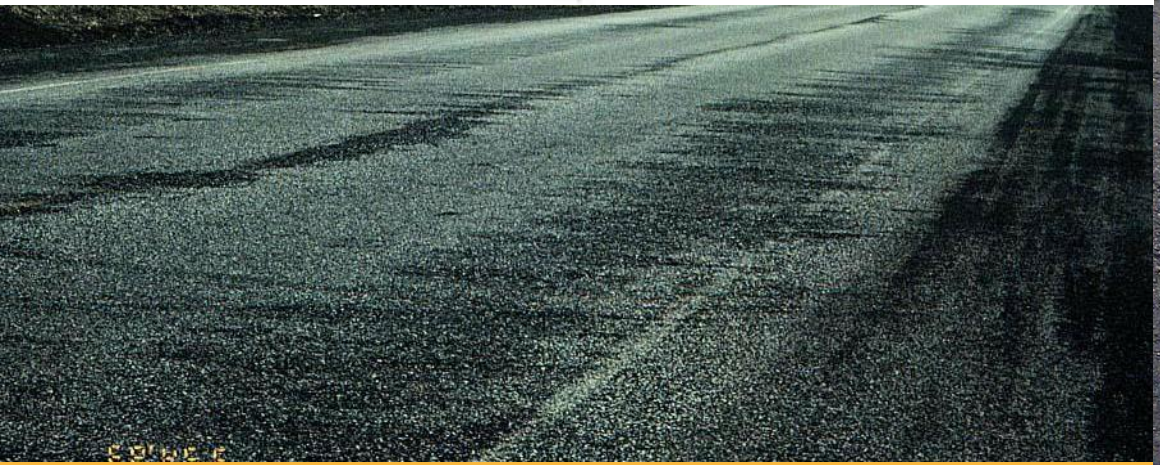
- Measures Permanent Deformation
- Fiber had 11.6x higher flow number than the control

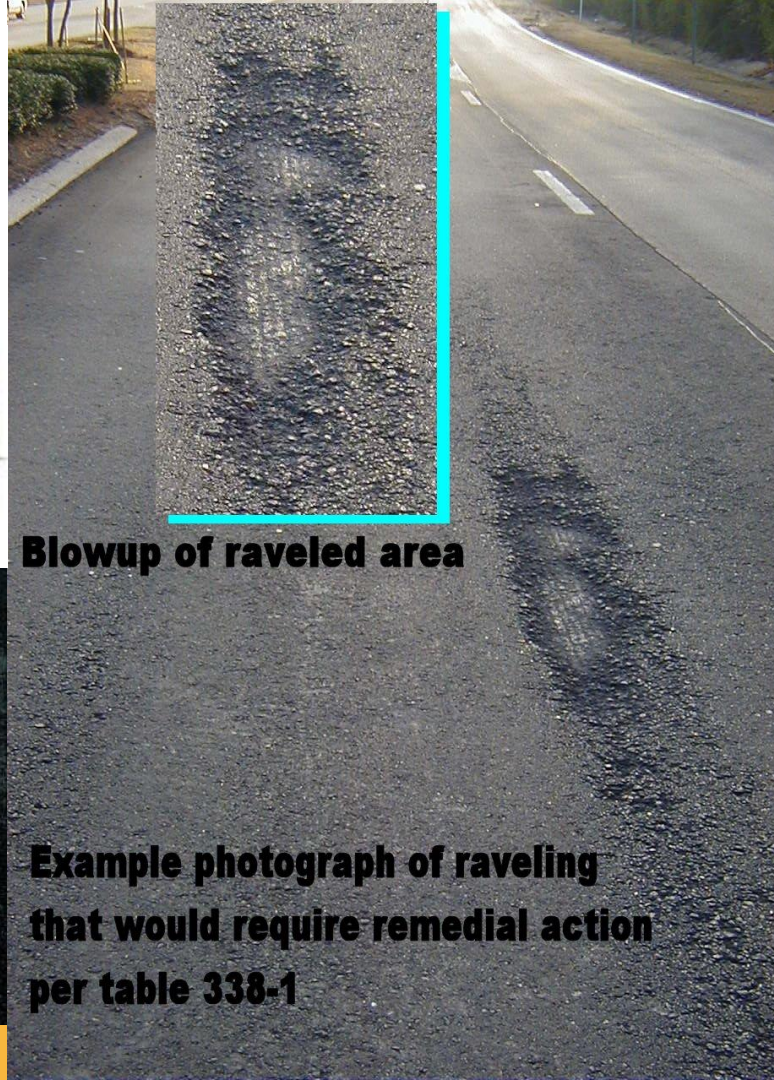


Rutting – Top Layer









Blowup of raveled area

Example photograph of raveling that would require remedial action per table 338-1

AUTOBAHN A9 - GERMANY *HIGHWAY*

CHALLENGE

Extend the service life of the Autobahn A9 highway by increasing the durability of the SMA mix that tends to ravel quickly

AutoBahn

* 10X Better Raveling Test

Jackson Hole

* 9 years, was 6-8

JACKSON HOLE AIRPORT- JACKSON, WY *AIRPORT*

CHALLENGE:
Raveling caused by airplane traffic leading to loose aggregates damaging jet engines

SOLUTION:
Replace runway and add FORTA-FI® into the mix to prevent raveling

NCAT

* 20M ESALs, No Raveling

ASU PCI Study

* Reduced Raveling 100%

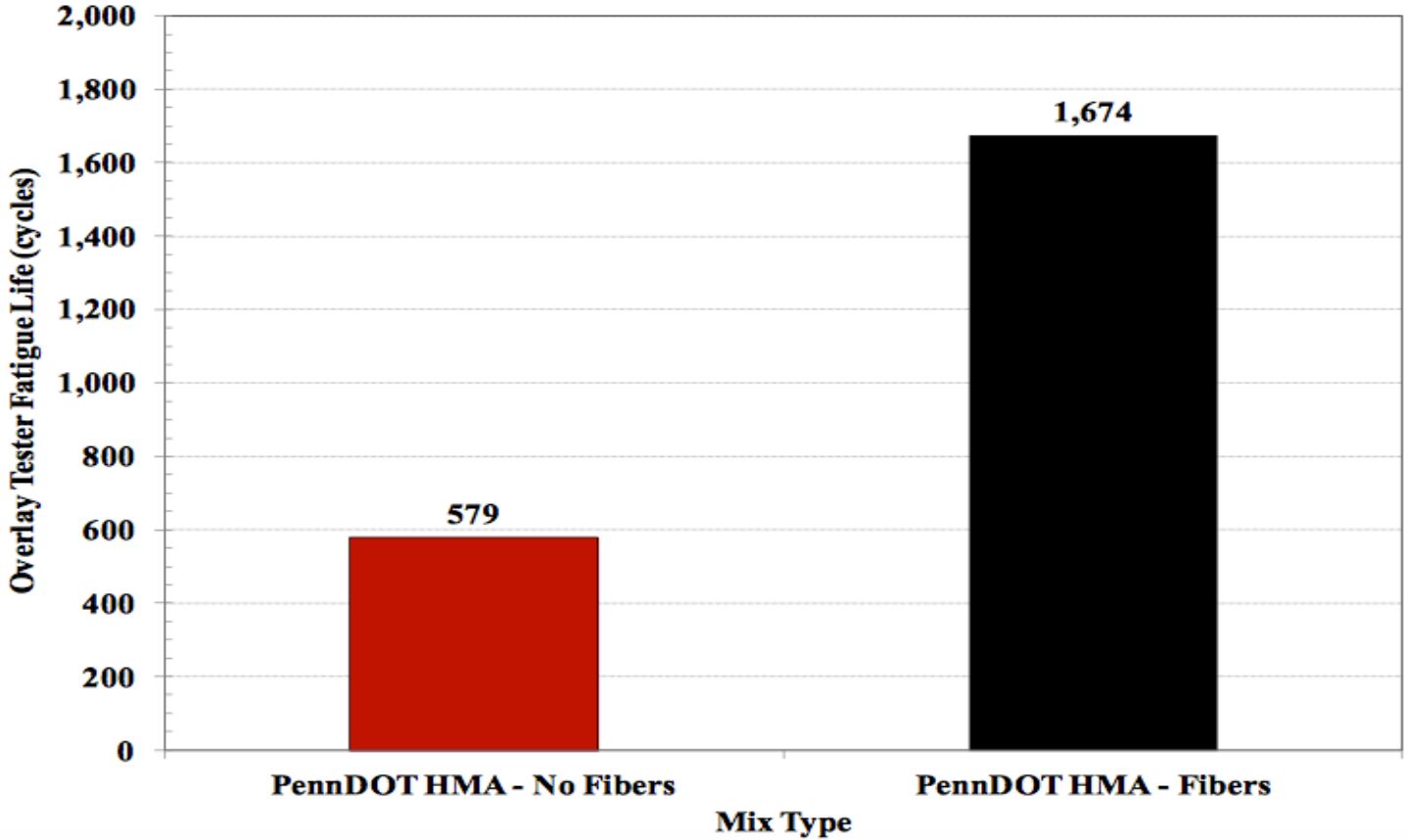
Reduce Raveling

Table 1. Comparison between original calculated and verified PCIs

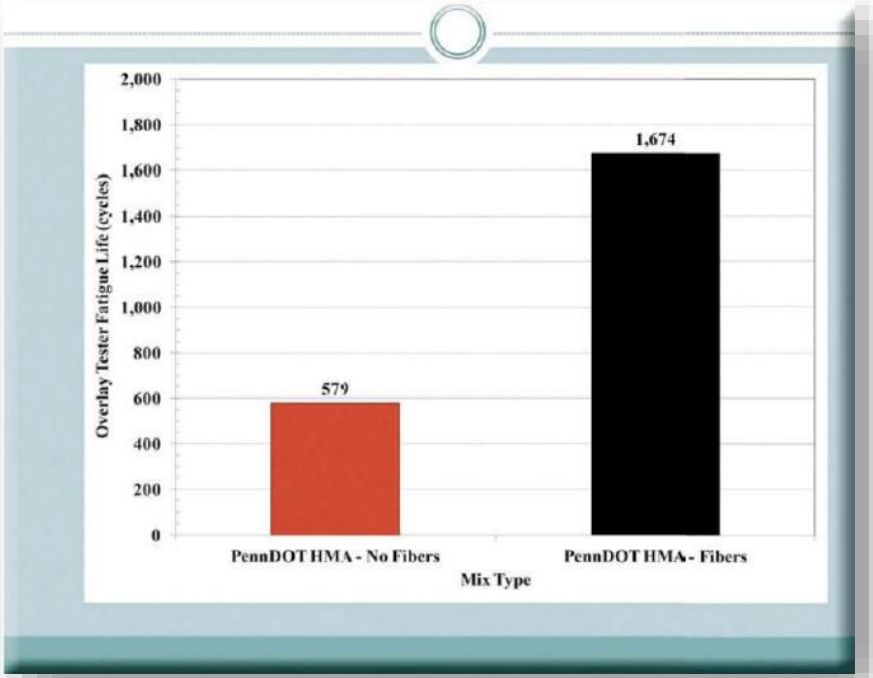
Branch	Section	Description	Severity	Quantity	Units	Density	Original		Verified	
							DVs	PCI	DVs	PCI
SR 3036	1	Alligator CR	Low	18.50	SqFt	0.28	4.78	95	4.54	93.46
		L&T CR	Low	80.00	Ft	1.19	2.59		2.24	
		Patch/cut	Low	3.00	SqFt	0.04	0.00		0.00	
	2	Alligator CR	Low	120.75	SqFt	1.80	15.64	72	15.30	69.08
		Alligator CR	Medium	18.00	SqFt	0.27	10.81		11.10	
		L&T CR	Low	73.00	Ft	1.09	2.28		1.97	
		L&T CR	Medium	40.50	Ft	0.60	5.32		5.55	
		Raveling	Medium	746.00	SqFt	11.12	19.32		18.90	

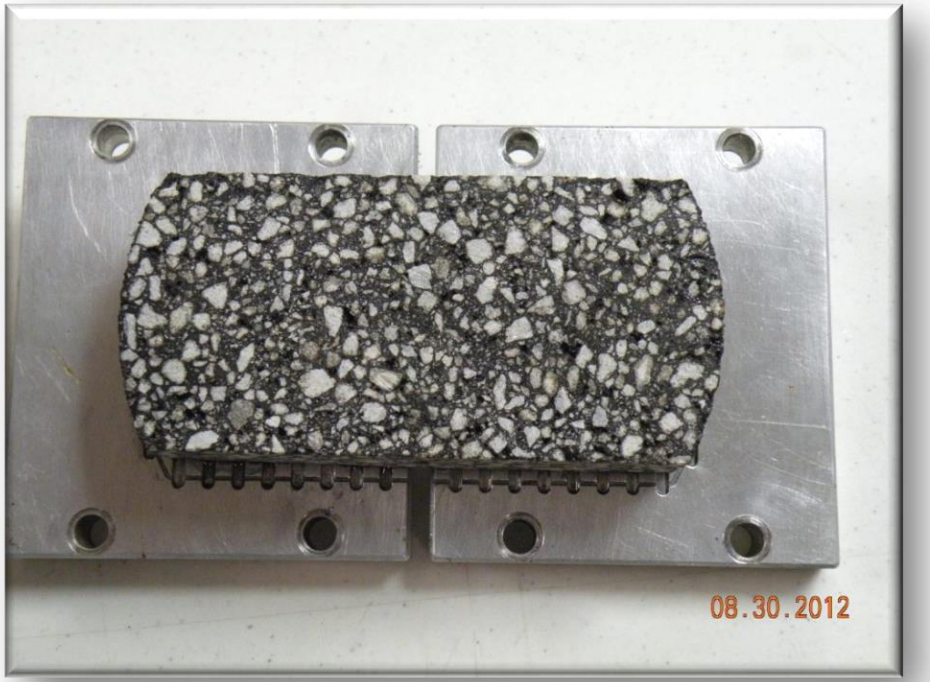
Reduce Cracking

Crack Testing

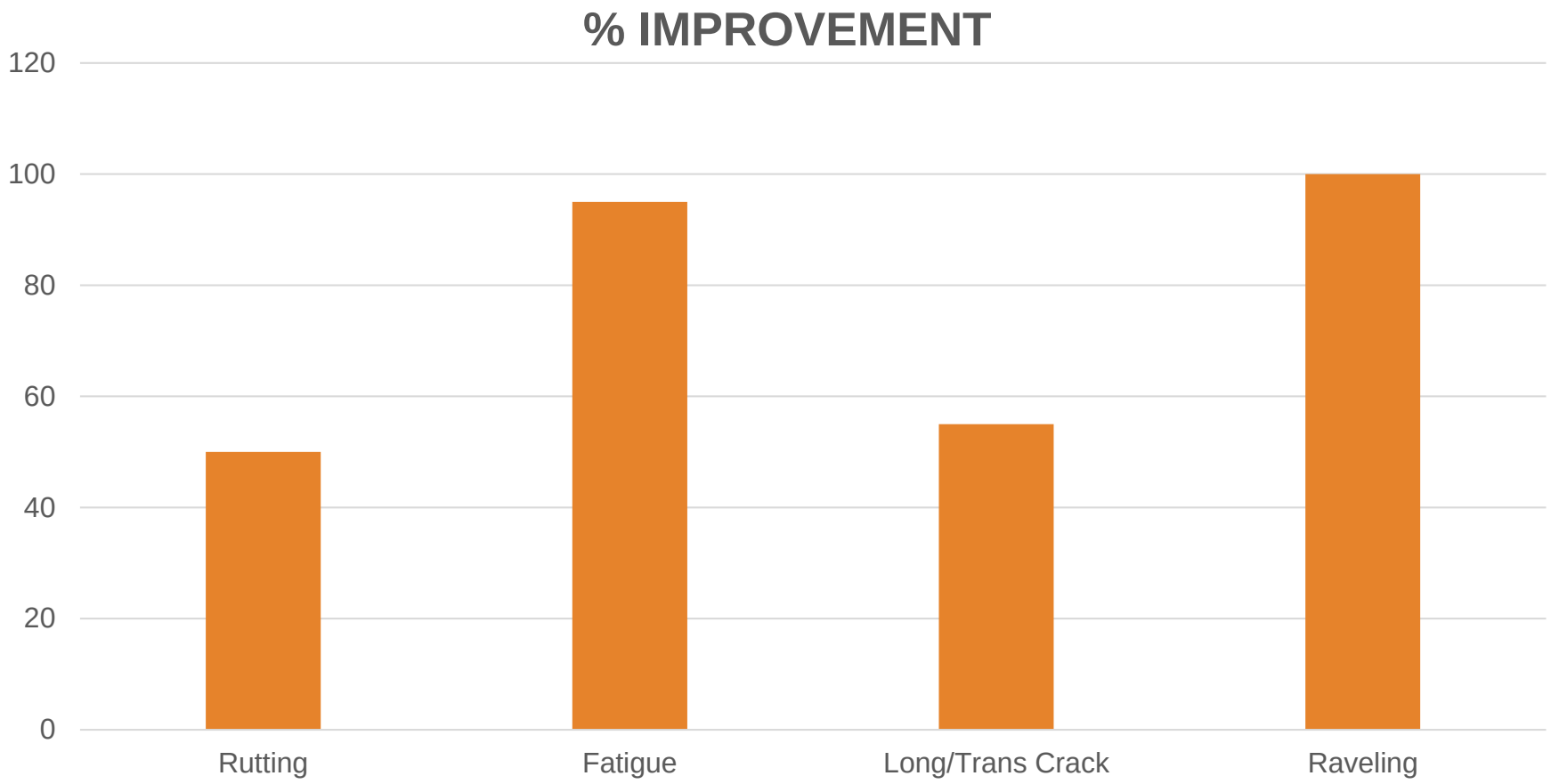


Texas Overlay Tester Plates





Reduce Cracking


% IMPROVEMENT
120
100
80
60
40
20
0
Rutting
Fatigue
Long/Trans Crack
Raveling

THE PERIODIC TABLE OF ELEMENTS

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 -	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 -	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 MD	102 No	103 Lr

Thinning to compete against concrete

Save Now

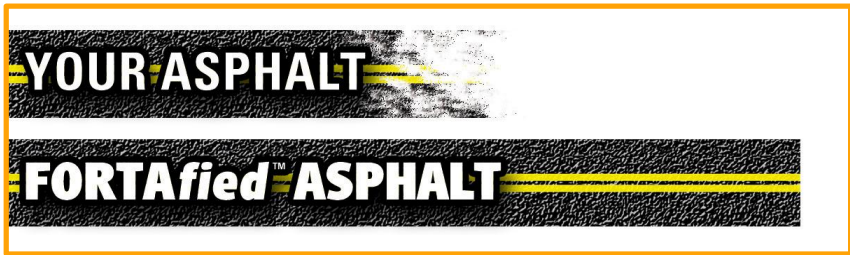
Use 35% Less Asphalt Thickness

Stronger than your traditional asphalt mixture

Save Down the Road

Lasts 50% Longer

Reduce cracking and rutting



FORTA®

FORTA-FI®

PROJECT PROFILE

DENSE GRADED HMA

STATE ROUTE 2020 - PHILADELPHIA, PA

FORTA®

FORTA-FI®

PROJECT PROFILE

OGFC

2014

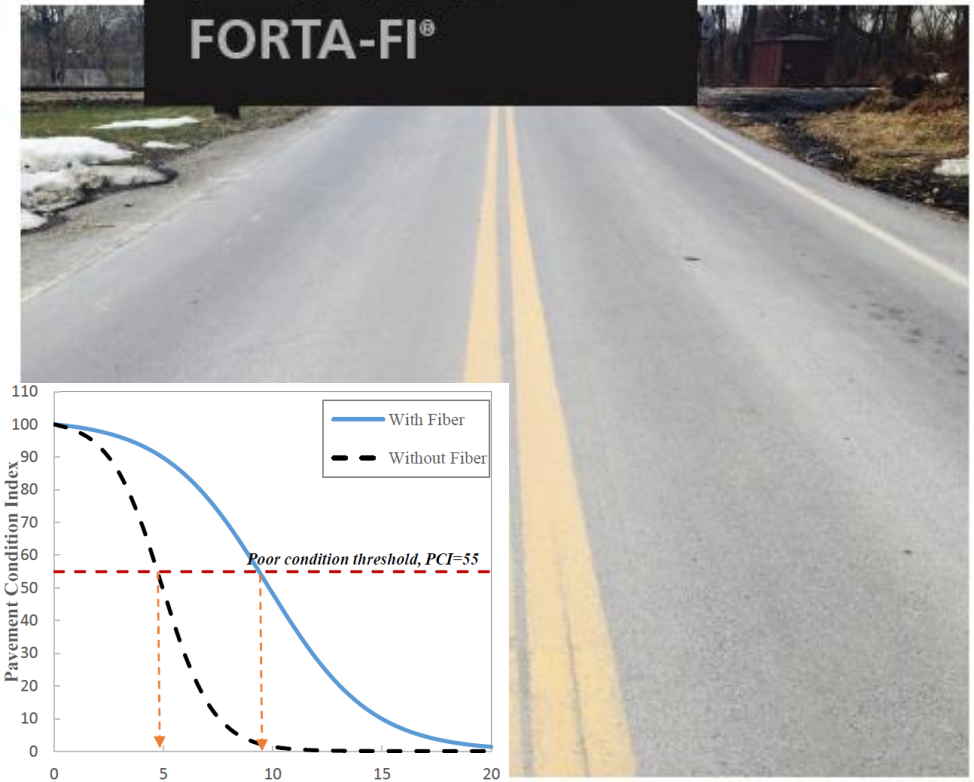
JACKSON HOLE AIRPORT - JACKSON HOLE, WY

FORTA®

FORTA-FI®

PROJECT PROFILE

DENSE GRADED HMA

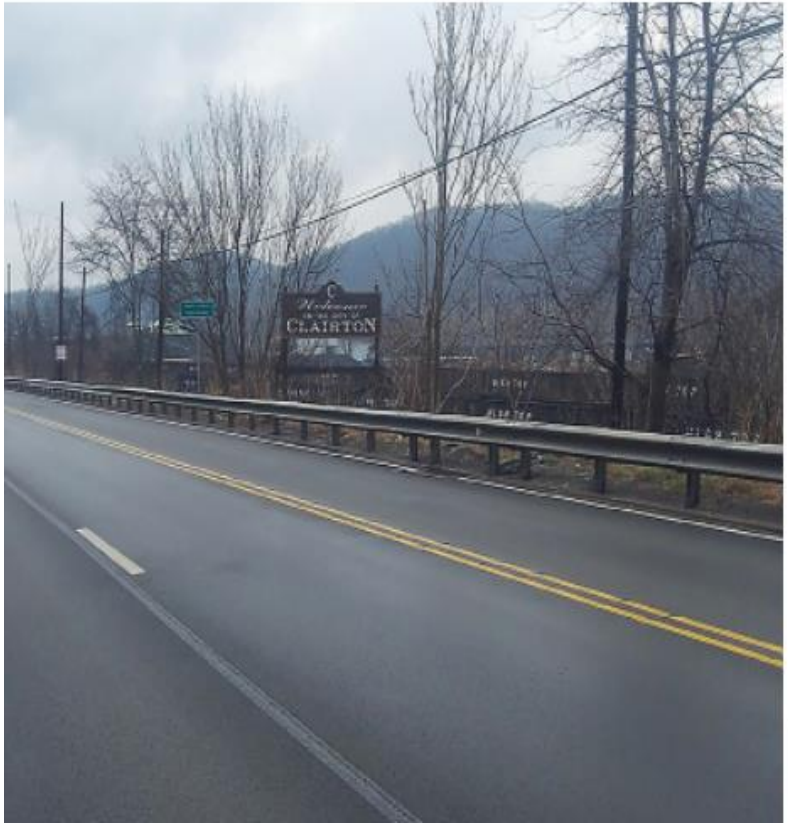


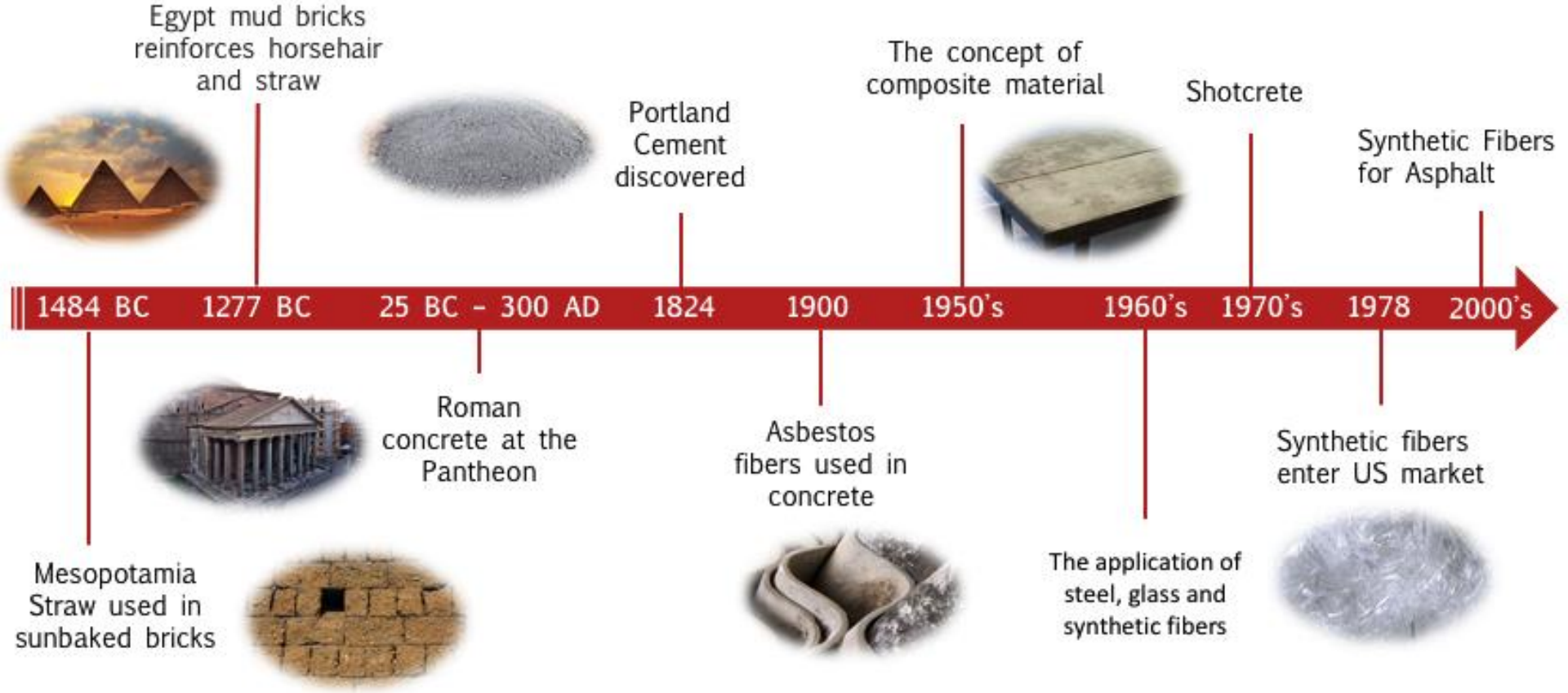
Branch	Section	Description	Quantity	PCI	Rating
SR 3036	Fiber	Alligator CR L & T CR Raveling	19 sq. ft. 80 ft None	95	Good
	Control	Alligator CR L & T CR Raveling	139 sq. ft. 113 ft. 746 sq. ft.	72	Satisfactory

STATE ROUTE 3036 - LANCASTER COUNTY, PA

STATE ROUTE 837 - CLAIRTON, PA

OVERLAY




Egypt mud bricks reinforces horsehair and straw
Portland Cement discovered
The concept of composite material
Shotcrete
Synthetic Fibers for Asphalt
1484 BC
1277 BC
25 BC - 300 AD
1824
1900
1950's
1960's
1970's
1978
2000's
Roman concrete at the Pantheon
Asbestos fibers used in concrete
Synthetic fibers enter US market
Mesopotamia Straw used in sunbaked bricks
The application of steel, glass and synthetic fibers

Where in the world is FORTA-FI®?

Thank You

www.forta-fi.com